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BALLISTIC MISSILE DEFENSE PROGRAM INFORMATION PACKAGE

DEPARTMENT OF DEFENSE
BALLISTIC MISSILE DEFENSE ORGANIZATION

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HISTORY OF THE BALLISTIC MISSILE DEFENSE ORGANIZATION

INTRODUCTION

Tonight, consistent with our obligations under the ABM Treaty and recognizing the need for close consultation with our allies, I am taking an important first step. I am directing a comprehensive and intensive effort to define a long-term research and development program to begin to achieve our ultimate goal of eliminating the threat posed by strategic nuclear missiles... Our only purpose - one all people share - is to search for ways to reduce the danger of nuclear war.

- President Ronald Reagan, March 23, 1983

The Ballistic Missile Defense Organization (BMDO) traces its roots to the Strategic Defense Initiative (SDI) program that President Ronald Reagan started in March 1983. SDI sought to find an alternative to the doctrine of mutually assured destruction, which relied on the threat of massive nuclear retaliation to deter Soviet actions that might lead to nuclear war. After a year of studies and preparation, Secretary of Defense Caspar Weinberger chartered the Strategic Defense Initiative Organization (SDIO) in April 1984.

In May 1993, the Department of Defense changed SDIO to BMDO in recognition of the radically altered international security environment. This change signified a reorientation of ballistic missile defense policy to place primary emphasis on developing and fielding advanced theater missile defenses.

HERALDRY OF THE STRATEGIC DEFENSE INITIATIVE ORGANIZATION AND THE BALLISTIC MISSILE DEFENSE ORGANIZATION

The symbol of the original Strategic Defense Initiatives Organization (SDIO) was a defensive shield and five stars representing the constellation Scutum, meaning shield. While the new Ballistic Missile Defense Organization (BMDO) logo contains some obvious changes, most notably the addition of symbols representing the three major services that participate in the ballistic missile defense program, it retains the shield motif to emphasize continuity of mission from SDIO to BMDO.

ACHIEVEMENTS

The SDIO program produced several significant technological advancements. SDIO's Flexible Lightweight Agile Guidance Experiment (FLAGE) and Exoatmospheric Reentry Vehicle Interceptor System (ERIS) were built on the Army's Homing Overlay Experiment, which demonstrated the feasibility of a reentry vehicle mid-course intercept, and small radar homing interceptor technology base. These programs have advanced kinetic kill technology to the point where it has proven to be cost effective, reliable and judged to have the best performance against weapons of mass destruction.

Capitalizing on the directed energy weapons (DEW) work of the Advanced Research Projects Agency and the Air Force, SDIO pushed back the frontiers of laser development to where it was possible to test a fully integrated laser system. Among SDIO's other DEW accomplishments was the development of mirror coatings that eliminated the need for heavy cooling systems and the advancement of deformable mirrors which astronomers use extensively today.

The SDIO's success in miniaturizing components in virtually all areas of missile defense technology has been fundamental to the progress made over the past ten years. One example of this miniaturization is SDIO's development of thrusters that weighed little more that eleven pounds yet produced over 10,000 pounds of thrust.

In addition to producing major technological accomplishments, the SDI program played a key role during the Cold War by renewing hope that the U.S. could find an alternative to mutually assured destruction. At the same time SDIO mobilized major elements of the U.S. technology base and focused them on missile defense, a vital area in the superpower rivalry. This caused concern in the Soviet Union and limiting the SDI program became an objective of Soviet arms control negotiators.

MISSILE DEFENSE TODAY

The end of the Cold War brought a relaxation of tensions between America and the Soviet Union and reduced concerns about nuclear war. However, a major new threat emerged: the spread of ballistic missile technology and weapons of mass destruction into new parts of the world.

The danger posed by this proliferation prompted a refocusing of SDIO on protecting the U.S. homeland against limited missile attacks and defending theaters against shorter range ballistic missiles. The decision to reorient the U.S. missile defense program was validated by the Gulf War, with its battles between Patriot and Scud missiles.

In keeping with this reorientation, on May 13, 1993, Secretary of Defense Les Aspin changed the name of SDIO to BMDO. SDIO's missile defense technology base became the foundation for the new missile defense program that emerged from a major study of U.S. defense requirements for the post-Cold era. This study was called the Bottom-Up Review.

Under its new charter, BMDO set out to implement the program prescribed by the Bottom-Up Review and adopted the motto: Making Missile Defense a Reality. An important facet of BMDO's effort was the involvement of DoD's warfighting commands in planning to integrate missile defense systems into operational units. Another significant feature of BMDO's management approach entailed injecting new technology into currently deployed systems. An example of this philosophy in action is the planned addition of a ballistic missile defense capability to the Navy's AEGIS air defense system.

Among BMDO's greatest achievements has been the successful testing of the Extended Range Interceptor (ERINT), the first application of hit-to-kill technology for an operational system. In 1994, the Army selected ERINT as the interceptor to be used in the Patriot Advanced Capability-3 (PAC-3) program. This opened a new page in missile defense technology. Prior to ERINT, missile defense interceptors relied on warheads with nuclear or conventional explosives to destroy their targets. The PAC-3 hit-to-kill defense system will be deployed in 1998.

One of BMDO's priorities has been to field improved defenses. Successes in this area have included deployments of Patriot Advanced Capability-2 Guidance Enhanced Missiles (GEM) and U.S. Marine Corps HAWK upgrades. Significant improvements to our ballistic missile early warning capabilities such as the Air Forces Attack and Launch Early Reporting to Theater (ALERT) squadron and the Joint Tactical Ground System (JTAGS) are also a result of work done by the BMDO.

Building on the work of the Services and SDIO, BMDO continues to lead the revolution in missile defense technology.

BMDO TECHNOLOGY MAKES COMMERCIAL SENSE

Many corporations have incorporated BMDO-funded technology - which includes some of the most advanced innovations in the world - into their product lines, giving them the competitive edge in what is now an extremely dynamic international marketplace.

- At least 28 companies have spun off from Federal laboratories, private companies, or universities to commercialize BMDO-funded technology
- Roughly 170 new commercial products have resulted from BMDO-funded technologies
- Eight companies funded by the BMDO Small Business Innovation Research program have gone public
- Over 230 ventures have been formed using BMDO-funded technology as a basis
- At least 200 patents have resulted from BMDO funding, with 150 more pending

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U.S. BALLISTIC MISSILE DEFENSE PROGRAM FOCUS

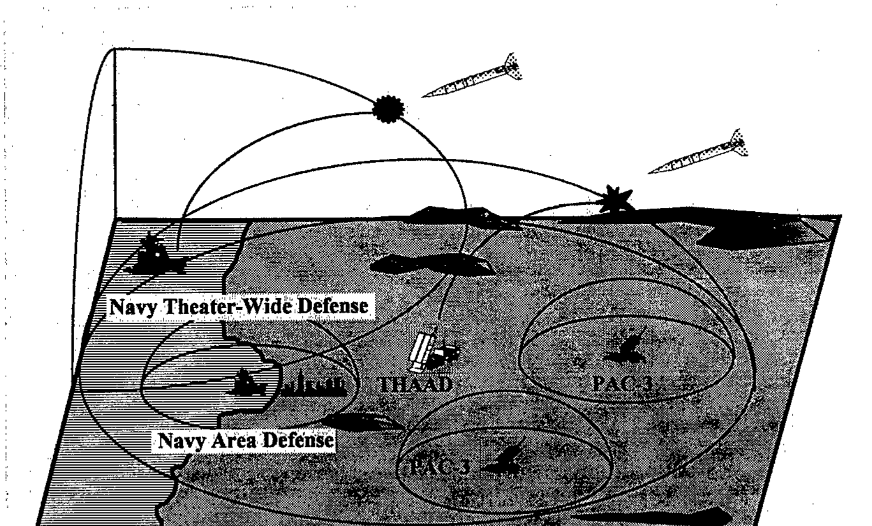
INTRODUCTION

Ballistic missiles have been a threat to the U.S. and its military operations for fifty years. During the Cold War, the strategic balance and deterrence between Soviet and U.S. forces held this threat in check. However, deterrence may not work if ballistic missiles proliferate to states that spurn its principles. The danger is compounded when combined with the spread of weapons of mass destruction. As a result, the U.S. government has determined that proliferation of ballistic missiles is one of the greatest dangers to U.S. national security and will remain so into the foreseeable future.

The Ballistic Missile Defense Organization (BMDO), an agency of the Department of Defense (DoD), is now working to provide active defenses against ballistic missile attacks and to provide a technical base that will allow DoD to hedge against increasingly sophisticated missiles around the world.

PROGRAM AREAS

BMDO has three broad program areas, each addressing a different area of BMDO's mission: Theater Missile Defense, National Missile Defense, and The



Theater Ballistic Missile Defense In-Depth

Advanced Technology Program. Together, they help ensure that the U.S. can deal with missile threats in an effective and sustainable manner.

1. Theater Missile Defense

The mission of theater missile defense (TMD) is to protect U.S. forces, allies and other countries, including areas of vital interest to the U.S., from theater missile attacks. The TMD mission includes protection of population centers, fixed civilian and military assets and mobile military units.

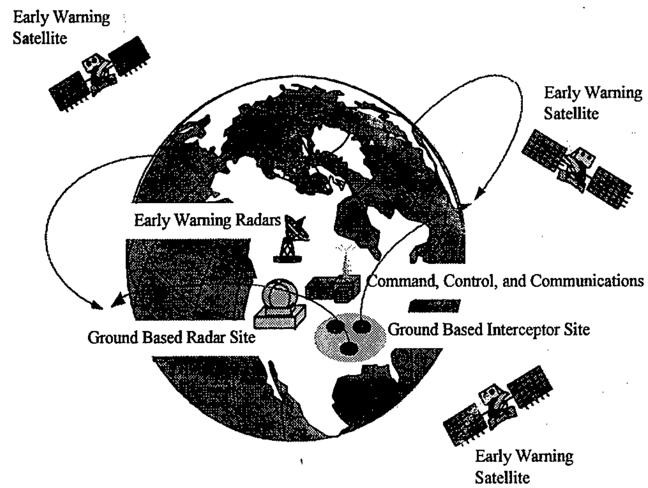
TMD concentrates on the immediate ballistic missile threat and has the highest priority of the three programs because this current threat holds the highest risk to U.S. forces.

BMDO is working to develop both land and sea based TMD systems to give our forces the greatest flexibility and provide the most effective TMD.

The theater missile defense arena is divided into an upper and a lower tier, basically defined by the altitude at which intercept takes place, the speed of the interceptor and the speed of the enemy missile. TMD systems are built to operate best in one tier, although there may be some crossover capability. This allows the systems to best match and negate specific types of missile threats. Moreover, this arrangement gives TMD forces multiple opportunities to destroy an incoming missile as it passes through the tiers.

Different systems are assigned to each tier. The Theater High Altitude Area Defense system (THAAD), Navy Theater-Wide Defense (NTWD) and Airborne Boost-Phase Intercept (BPI) operate in the upper tier while the Patriot

Advanced Capabilities - 3 (PAC-3), the Navy Area Defense, and the Medium Extended Air Defense System (MEADS) cover the lower tier. THAAD, Navy Area Defense and PAC-3 are collectively referred to as the TMD Core programs. NTWD, MEADS and BPI are advanced concepts programs. Only three of these systems -- PAC-3, THAAD, and the Navy Lower Tier -- are presently in the acquisition stage.



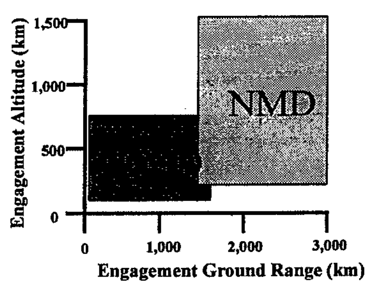
National Missile Defense

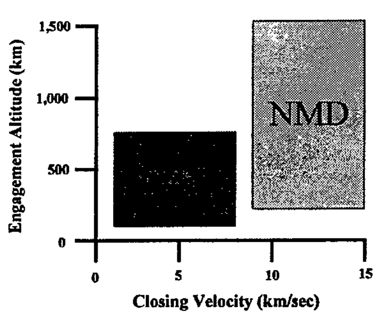
2. National Missile Defense

The national missile defense (NMD) program is concerned with the possibility of a limited ballistic missile strike against the U.S. homeland. Although this danger has yet to materialize, many warning signs are now evident. NMD program researchers are developing the technology needed to create a national missile defense system geared to counter a limited threat. The decision to deploy such a system depends on the future threat to the U.S. In light of current threat projections and to stay within technical and financial parameters, NMD program developers are not planning to deploy or develop a comprehensive national missile defense system able to repel a large massed strike.

The "deployment readiness" approach balances the danger of attack against the cost of development, our international treaty obligations, and the possibility of a beneficial technological breakthrough in the future. The NMD program also consists of preparing options for rapid deployment with contemporary technology in case a sudden threat emerges.

Theater Missile and National Missile Defense Requirements





NMD Systems

Ground Based Interceptor (GBI): The GBI is planned to be a silo-based system that will use an exoatmospheric (outside the atmosphere) kill vehicle (EKV) to destroy target missiles in non-nuclear, hit-to-kill interceptions. The EKV design is currently under critical review and will undergo seeker fly-by tests in FY97.

Sensors: The NMD Ground Based Radar would provide target tracking, discrimination, and kill assessment. Currently, NMD program developers are constructing a testbed radar to resolve several technical issues. Other sensors include ground and space based early warning radars that use passive and active means to detect threats. These sensors are essential for nationwide defense.

Battle Management/Command, Control, and Communications (BM/C3): The BM/C3 program would integrate the NMD interceptor and sensor operations. At present, the BM/C3 element is primarily intended to help determine the best

3. The Advanced Technology Program

The Advanced Technology Program supports research on new technologies and provides options for improvement to existing systems. These new ideas include technologies such as the kinetic energy interceptor, advanced surveillance and tracking sensors, and directed energy systems. This program is essential to keep the BMD program cost effective, relaible, and ahead of the increasingly sophisticated global missile threat.

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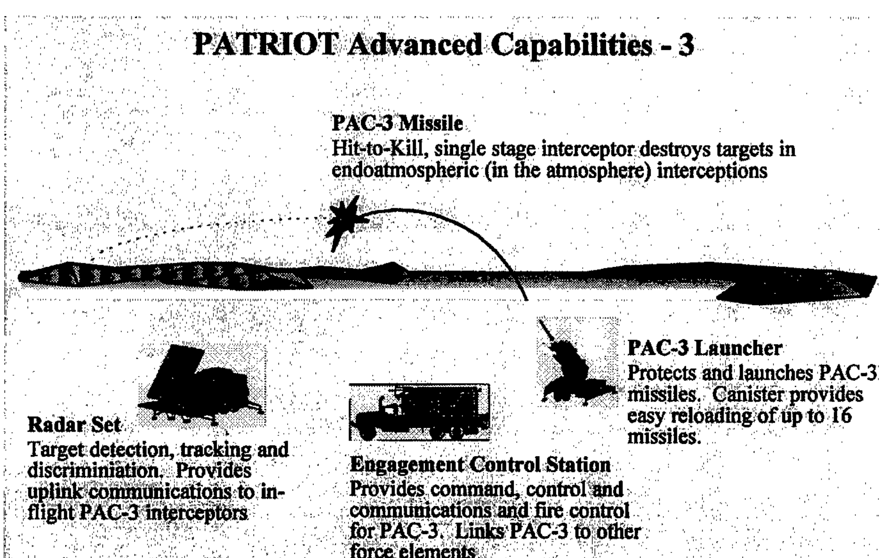
BALLISTIC MISSILE DEFENSE - THE CORE PROGRAMS

INTRODUCTION

The Ballistic Missile Defense Organization (BMDO) Core Programs consists of those systems that have been selected to form the bedrock of the theater missile defense (TMD) architecture. The three core systems are PATRIOT Advanced Capability-3 (PAC-3), Navy Area Defense and Theater High Altitude Area Defense (THAAD) systems. These three core TMD programs represent the bulk of BMDO's research, development, test & evaluation (RDT&E) and procurement budget for fiscal year (FY) 1996. The variety of scenarios and threat characteristics (maximum/minimum ranges, reentry vehicles, radar cross sections, etc.) and the characteristics of the defended areas (military forces, population centers, ports of debarkation, etc.) require complementary systems for complete and cost-effective defense. Therefore, BMDO is developing the core systems which will begin deployment by the end of this decade and will greatly improve U.S. defense capabilities against the existing theater ballistic missile threat.

PATRIOT Advanced Capabilities - 3

PAC-3 is the most recent version of the famous PATRIOT system that was so prominent during the Gulf War. By 1999, the PAC-3 system will be used to help defend the lower tier of the ballistic missile defense (BMD) architecture. This mission will include defending troops and fixed assets from short and medium range ballistic missiles, cruise missiles, and other air breathing threats such as fixed or rotary wing aircraft. The PAC-3 will destroy targets by ramming them while they are inside the Earth's atmosphere -- a process called endoatmospheric hit-to-kill interception. The PAC-3 is designed to be easily deployed anywhere in the world and can be transported aboard C-141 or C-5 aircraft.



PAC-3 development will be an incremental process through three increasingly sophisticated versions. Over the next two years, the two initial versions will be built and deployed in order to provide a missile defense to our troops as quickly as possible. In 1999 the final PAC-3 system will reach the field and begin replacing the older systems.

The final PAC-3 system will field improvements to virtually all system components. Upgrades to the radar will improve its multifunction and low altitude capabilities, threat detection, and threat discrimination. The Extended Range Interceptor (ERINT) will become the standard PAC-3 missile, greatly increasing PAC-3 lethality. Other improvements include better command, control, and communications, and greater interoperability.

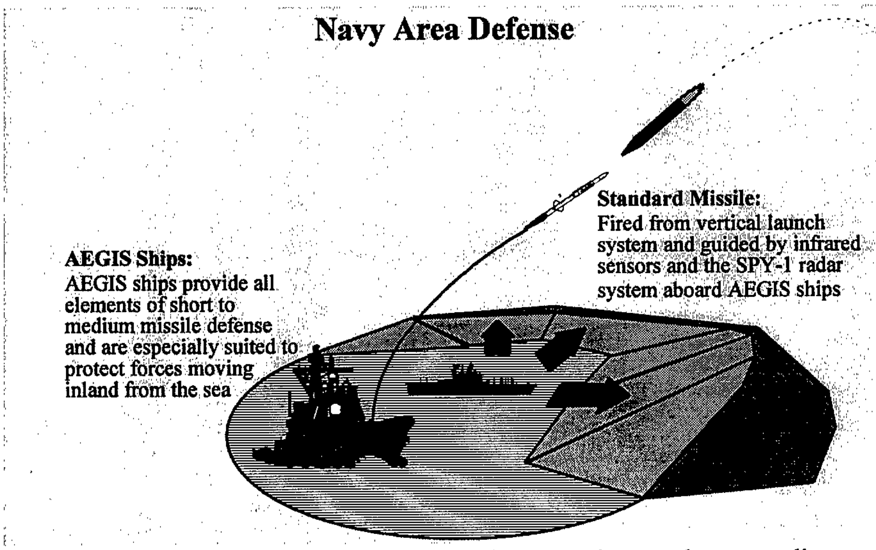
The PAC-3 system has four main components: the radar set, the Engagement Control Station, the launcher, and the PAC-3 missile.

Navy Area Defense

The Navy Area Defense system is based on the Navy's AEGIS class cruisers and destroyers, which already form the backbone of the U.S. fleet. With some relatively minor and inexpensive modifications, these ships can be adapted to a ballistic missile defense role. The changes include upgrading the AEGIS-based Standard Missile (SM-2 Block IV) and the SPY-1 radar and computer programs. This will provide for a defense capability against shorter-range theater ballistic missiles (TBMs) and permit endo-atmospheric (within the atmosphere) interceptions while preserving the ships cruise missile defense capability. The ships will not need additional manning to take on this role and already have the infrastructure in place for training, logistics and engineering.

Sea-based TMD offers several unique advantages. Sea basing allows missile defenses to station offshore near potential crises spots where land-based TMD forces may have difficulty deploying. Furthermore, because the Navy Area Defense system can operate in international waters, it avoids the need to secure the approval of a foreign government before deployment. Finally, ship-based TMD helps alleviate demands placed on airlift and sealift during crisis times.

A user operational evaluation system is planned to be available in FY 2000 and the First Unit Equipped (FUE) should occur in FY 2002.

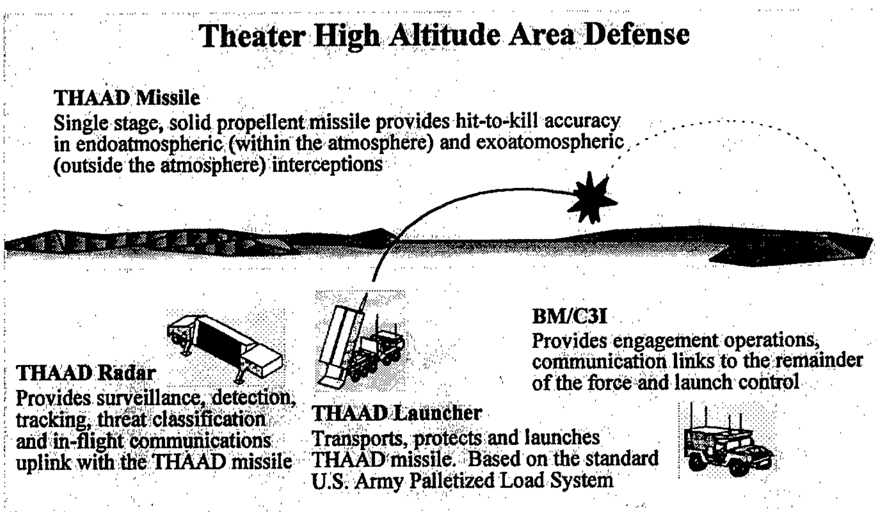


Theater High Altitude Area Defense

The THAAD system will form the largest umbrella of missile protection in a theater, arching over all other missile defense systems. To meet this objective, THAAD will have the longest range and highest intercept altitude of any BMD system and will be able to destroy threats both outside and inside the Earth's atmosphere in hit-to-kill interceptions. THAAD's long range and high speed will also allow it to engage a threat, assess the success of that engagement, and, if necessary, fire a second missile. These abilities permit THAAD to defend against the entire spectrum of theater ballistic missile threats. Moreover, THAAD will give U.S. forces the earliest opportunity to shoot down incoming missiles and the best chance to destroy them at a distance, thereby preventing post-intercept debris from falling on our troops -- a vital consideration if an enemy missile carries a weapon of mass destruction. To support rapid deployment, the entire THAAD system can be airlifted by C-141 aircraft.

Development on the THAAD system started in 1992 and is expected to run through 2004 when the first units will be equipped in the field. Beginning in 1998, some prototype THAAD systems, called user operational evaluation systems (UOES), will be provided to units in the field to allow the Army to "test drive" the system before further development takes place. The UOES battalion may also be used to provide missile defense in case a national emergency occurs before the full fledged THAAD systems are delivered in 2004.

THAAD is composed of the Ground Based Radar, the THAAD launcher, the THAAD missile, and THAAD battle management/command, control, communications and intelligence (BM/C3I).



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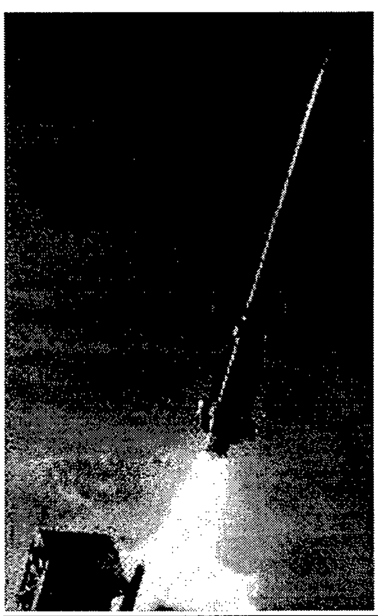
PATRIOT ADVANCED CAPABILITY-3 (PAC-3)

BACKGROUND

During the Gulf War, the PATRIOT air defense system made its now-famous battlefield debut against tactical ballistic missiles. However, the system originated years before it ever saw action in the Persian Gulf. In fact, the first PATRIOT was deployed in 1985. Initially, PATRIOT focused on air defense rather than missile defense, but the changing battlefield and the increasing threat from ballistic missiles spurred PATRIOT through a succession of improvements and modifications to refocus its mission on missile defense. This foresight paid off during the Gulf War, when the PATRIOT helped defend coalition forces and Israeli territory from Iraqi Scud missile attacks.

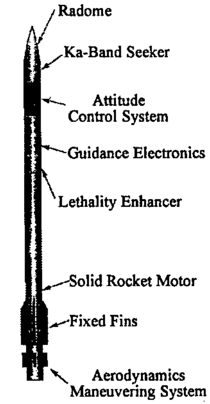


Today, the effort to improve the PATRIOT system and its ballistic missile defense capabilities continues as the latest version, called the PATRIOT Advanced Capability-3 (PAC-3), nears completion. The series of enhancements planned for PAC-3 will preserve its position as one of the fundamental ballistic missile defense systems in the U.S. arsenal.

PAC-3 Missile Characteristics:
Weight 312.4 kg
Length 5 m
Diameter 255 mm

MISSION

The PATRIOT has always been an important part of our air and missile defense. However, in recent years the PATRIOT system has become even more integral to our theater missile defense (TMD) plan. Today it is considered to be a core TMD program with one of the highest priorities in the development of ballistic missile defense (BMD) systems.



PATRIOT (PAC-3)

PAC-3's mission is to defend the lower tier of the BMD architecture. This includes defending troops and fixed assets from short and medium range ballistic missiles, cruise missiles, and other air breathing threats such as fixed or rotary wing aircraft. To accomplish this mission, PAC-3 is designed to be a highly advanced missile defense system that can destroy enemy threats with hit-to-kill accuracy in the terminal phase of the missile's flight. PAC-3 is planned to be interoperable with other Army and Joint systems to provide a seamless missile defense in depth, and be air-transportable to support rapid deployments.

PROGRAM DEVELOPMENT & SCHEDULE

PAC-3 development will follow a series of evolutionary steps through three increasingly sophisticated versions of the PATRIOT, called Configuration 1, Configuration 2, and Configuration 3. The first unit to be equipped with Configuration 3 is scheduled for 1999.

The first step was the development of the PATRIOT Quick Response Program (QRP) and its deployment in 1993. This was an intermediate system that came out as a direct response to the Gulf War and the increasing danger from missile proliferation. Gulf War experiences gave the QRP better sensing equipment and a remote launch ability.

Baseline PATRIOT (PAC-3) Battery

- **4 Launchers per battery will be PAC-3 missile capable**
- **Increases the number of missiles from 32 to 56 with 2 PAC-3 launcher stations**
  - **32 PAC-3 missiles**
  - **24 PAC-2 missiles**
- **Designed to allow for an increase in the number of missiles from 32 to 68 using 3 PAC-3 launcher stations**
  - **48 PAC-3 missiles**
  - **20 PAC-2 missiles**
- **Engagement control station can control up to four PAC-3 launchers**

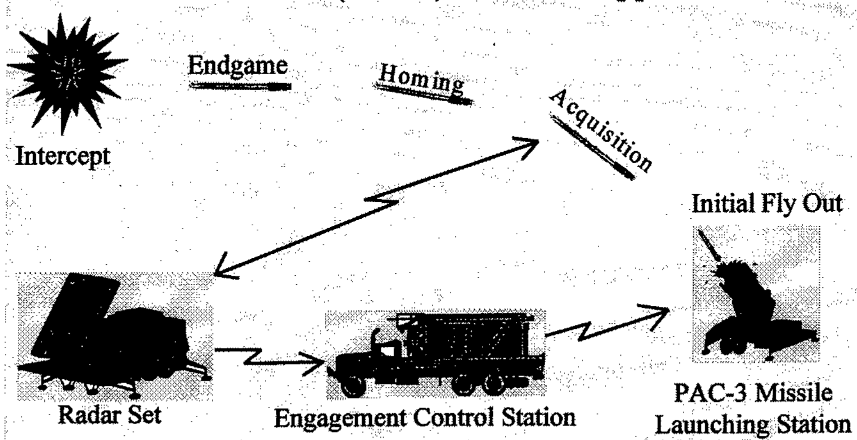
PAC-3 Configuration 1 is the first true PAC-3 system. It fields a number of improvements, especially in battle management, command, control, communications and intelligence (BMC^{3}I) and incorporates the Guidance Enhanced Missile (GEM). The first unit was equipped with Configuration 1 in December 1995.

The next step, equipping the first unit with PAC-3 Configuration 2, is scheduled for this year. The Configuration 2 will feature further improvements and modifications to the radar, communications, and other systems. One of the most prominent changes is a better classification, discrimination, and identification (CDI) ability.

In 1999, the process will culminate with the PAC-3 Configuration 3. This highly-advanced system will be the first to feature the new PAC-3 missile in conjunction with GEM and earlier missiles used in Configurations 1 and 2.

The PAC-3 missile is expected to greatly enhance PATRIOT's lethality and quadruple the firepower because of its smaller size and launcher load capability. Other changes planned for Configuration 3 include enhancing the radar, survivability, and providing a launch point determination capability.

PATRIOT (PAC-3) Guidance Approach



SYSTEM DESCRIPTION

All PAC-3 systems have four basic components: a radar set, an engagement control station (ECS), a launching station, and interceptors.

The radar station provides warning and tracking of incoming threats. It also provides a continuous update link with in-flight interceptors. Meanwhile, the ECS computes fire solutions for the interceptor, provides fire control and provides a communications link with other PATRIOT units. The ECS is the central nervous system of PAC-3 operations. The launch stations transport, protect, and launch the missiles. Each launch station can be equipped with four GEM or earlier missiles or 16 PAC-3 Configuration 3 missiles. Finally, the PAC-3 missile itself uses its high maneuverability and hit-to-kill accuracy to destroy its target in a catastrophic collision.

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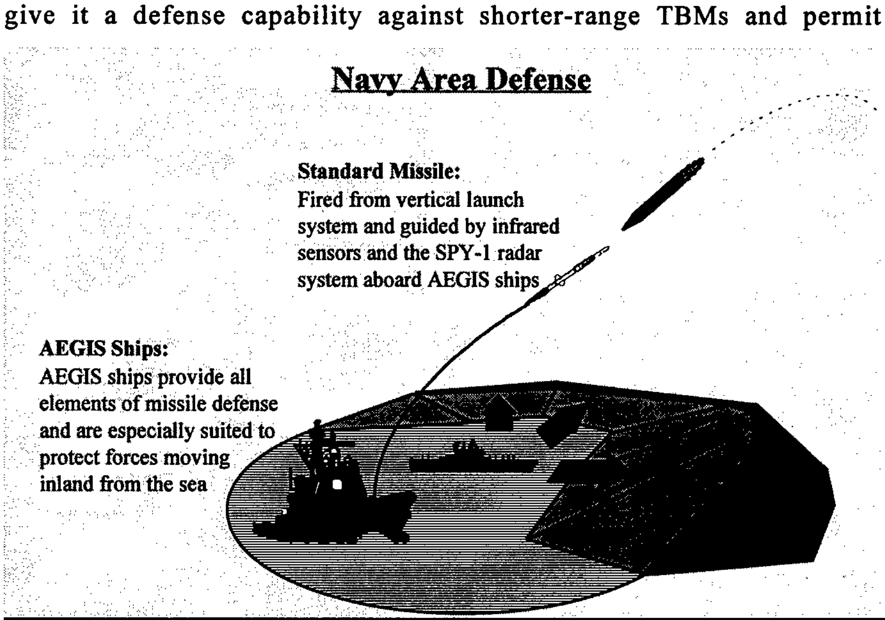
NAVY AREA DEFENSE BALLISTIC MISSILE DEFENSE PROGRAM

BACKGROUND

The first priority of the Navy and Marine Corps in Theater Missile Defense is the rapid fielding of the Navy Area tactical ballistic missile defense capability as a "core" system... There is a compelling national requirement for this capability and we need to move out to obtain it.

- Admiral Boorda, Chief of Naval Operations
- General Mundy, Commandant of the Marine Corps
  July 1994

The Navy and the Ballistic Missile Defense Organization (BMDO) have been working in partnership to develop a sea-based area defense capability which builds on the existing AEGIS/Standard Missile air defense system. This effort focuses on modifying the AEGIS combat system to extend its anti-air warfare capability to enable detection, tracking and engagement of tactical ballistic missiles (TBM). The AEGIS SPY-1 radar system, computer program and equipment will be modified to allow searches at higher elevations and longer ranges in order to detect and track TBMs. The AEGIS-based Standard Missile (SM-2 Block IV) will be upgraded to give it a defense capability against shorter-range TBMs and permit endo-atmospheric (within the atmosphere) interceptions while preserving its cruise missile defense capability.



A user operational evaluation system (UOES) is planned to be available in FY 1999 and the First Unit Equipped (FUE) should occur in FY 2001.

THE NAVY ROLE

Sea-basing of TBM defenses allows our nation to take advantage of the strength and presence of our naval forces. The Nation has already invested over $40 billion in more than 50 AEGIS cruisers and destroyers equipped with over 5,000 vertical launch system (VLS) cells. The AEGIS ships will require no additional manning for an area defense capability and already have the infrastructure for training, logistics and engineering in place and operating. With a relatively modest investment, the Navy can provide a substantial near-term payoff in area defense.

The Navy will have the flexibility to forward deploy, nearly indefinitely, sea-based TBM defense forces to potential crisis spots in regions where U.S. land-based forces could not so readily deploy. Since these sea-based forces would be deployed in international waters, no foreign governmental approval will be needed. Thus, an effective defense capability can be in place to provide Navy area defense before hostilities erupt or before land-based defenses can be transported to the theater. If U.S. forces have to fight their way into the theater of operation, Naval combatants could provide critical area defense coverage early in the conflict.

Navy Area Defense Addresses National TBM Defense Concerns

- **Will Protect U.S. Forces Deployed to Crisis Areas**
- **Provides Early Engagement and Defense in Depth to Reassure Coalition Allies**
- **Enable Reinforcements by Protecting Debarkation Ports, Airfields and Staging Areas**
- **Eases Strain Required for Timely Airlift and Sealift**
- **Deters Conflict**

Standard Missile launched from an AEGIS cruiser.

Additionally, TBM defense provided by ships at sea will greatly alleviate the demand on our airlift and sealift. Desert Storm demonstrated the time and resources required to move defense forces into a theater of operation with an active TBM threat. Deployed Naval forces with TBM defense capabilities will enable a theater commander to concentrate available lift on anti-armor, tanks, troops, ammunition and other reinforcements needed to stop an enemy advance.

COMMAND & CONTROL

The Navy has years of experience with Battle Force air defense and has deployed the command and control systems necessary to conduct area defense from the sea. The ability to integrate satellite communications, the Joint Tactical Information Distribution System (JTIDS), Tactical Related Applications/Tactical Receive Equipment (TRAP/TRE), Naval Tactical Command System-Afloat (NTCS-A), and other vital intelligence, sensor, and tactical information makes the Navy a logical choice to have a role in TBM defense.

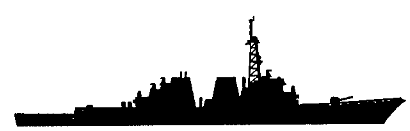
Forward Deployed Naval Forces
(AEGIS SHIPS DEPLOYED ON 10 JAN 1995)

Source: Navy TMD Brief 402213C.CDR OPNAV 012495

AEGIS SHIPS

TICONDEROGA CLASS GUIDED MISSILE CRUISER (AEGIS) (CG)

Displacement: 9450 Tons
Dimensions: Length - 567 ft
Width - 55 ft
Speed: 30+ knots



ARLEIGH BURKE CLASS GUIDED MISSILE DESTROYER (AEGIS)(DDG)

Displacement: 9200 Tons
Dimensions: Length - 509 ft
Width - 66 ft
Speed: 32+ knots

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THEATER HIGH ALTITUDE AREA DEFENSE SYSTEM (THAAD)

U.S. BMD STRATEGY & THAAD

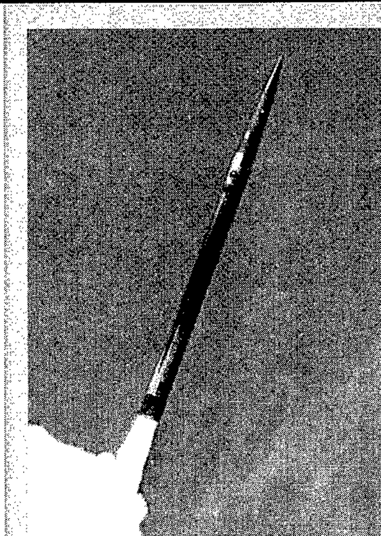
Over the past several years, the U.S. has become increasingly concerned about the possible proliferation of theater ballistic missiles and weapons of mass destruction in many of the world's high-threat regions. Ballistic missile defense (BMD) is designed to counter this problem by: (1) providing a missile defense for U.S. forces deployed abroad; and (2) devaluing ballistic missiles as strategic assets, thereby dissuading countries that desire a missile capability for aggressive purposes.

The Theater High Altitude Area Defense (THAAD) system fits into this strategy as one of the three core BMD systems. The THAAD system's role in this strategy is to form the largest umbrella of missile protection in a theater, arching over all other missile defense systems. To accomplish this mission, THAAD will have the longest range and highest intercept altitude of any BMD system, making it able to engage the entire spectrum of theater ballistic missiles.

THAAD SYSTEM OBJECTIVES

- **Defeat tactical theater ballistic missiles**
- **Intercept missiles inside and outside the atmosphere**
- **Engage at long ranges and high altitudes**
- **Give U.S. and allied forces multiple opportunities to intercept incoming missiles**

The THAAD system's ability to intercept missiles at long range and very high altitude (endo and exo-atmospheric) will give U.S. forces the earliest opportunity to shoot down incoming missiles and the best chance to knock them out far enough so that post-intercept debris will not harm our troops — a vital consideration if a missile carries a weapon of mass destruction. Furthermore, this ability will give U.S. BMD forces the time to judge the success of an intercept attempt and, if necessary, launch more interceptors from THAAD or other missile defense systems.



THAAD Test Flight April 21, 1995

PROGRAM DEVELOPMENT & SCHEDULE

The THAAD system is well along its development and deployment timescale. THAAD system development started in 1992 and is expected to run through 2004, when the first units in the field will be equipped. In the meantime, THAAD will undergo rigorous testing and development.

Initial flight tests are now underway. The first took place in April 1995, with three others completed that year. These tests are intended to prove out technical challenges with hit-to-kill technology and test system design. Tests to intercept a ballistic missile are planned for this year. The primary objectives for upcoming tests are to achieve intercept and to integrate the THAAD radar as the primary sensor.

Beginning in 1998, prototype THAAD systems, called user operational evaluation systems (UOES), will be provided to units in the field in order for the

THAAD OBJECTIVE CHARACTERISTICS

Missile & Kill Vehicle

Weight — 900 kilograms
Length — 6.2 meters
Seeker — Infrared Terminal Guidance

- Hit-to-Kill Precision
- Single stage rocket engine

Launcher

Height — 3.25 meters
Length — 12 meters
Weight — 40,000 kg loaded
Canister — 10 missile capacity

- Mounted on M1075 truck
- 30 minute reload time

Radar

Array Size — 10 m2

- X-band frequency
- Surveillance, threat identification & classification
- Support to other BMD systems
- Attack assessment

BM/C3I

- Force interoperability
- Fire control

Army to "test-drive" an operating THAAD battalion before further development takes place. The UOES battalions may also be used to provide missile defense in case a national emergency occurs before THAAD protection systems are fully deployed in 2002. The UOES is a major thrust and priority of the core TMD program. Congress appropriated BMD close to $600 million in FY96 for THAAD and its accompanying radar system.

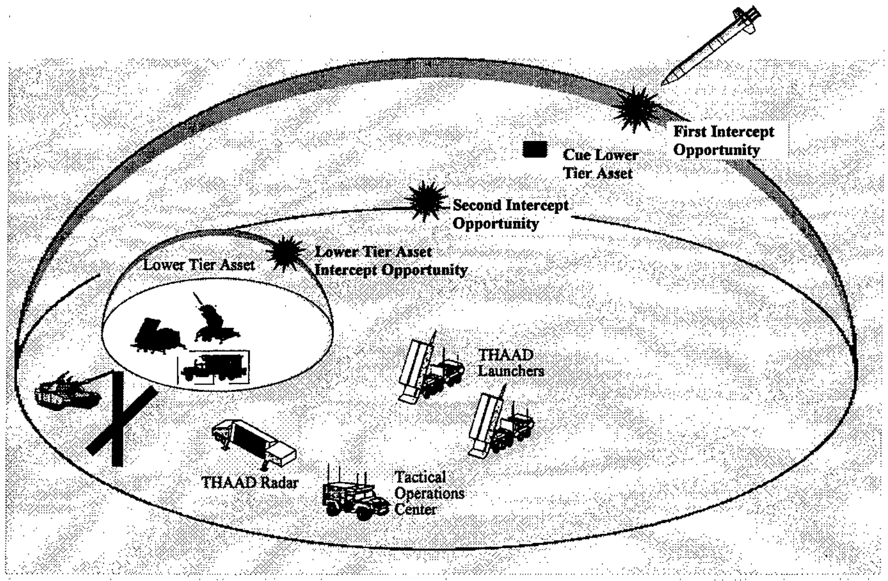
SYSTEM DESCRIPTION

The THAAD system consists of four major parts: truck-mounted launchers, interceptors, the THAAD Radar system, and the THAAD battle management/command, control, communications, and intelligence (BM/C3I) system.

The mobile launcher will protect and transport the interceptors, in addition to firing them. With its palletized load system, the launcher can be fully reloaded in less than thirty minutes. Interceptors will consist of a missile round and a kinetic kill-vehicle that will destroy targets by colliding with them, called "hit-to-kill." The THAAD radar will provide surveillance, target tracking, and fire control, and provide a communication link with in-flight THAAD interceptors. The radar will also be able to classify missile threats and cue interceptors from other BMD systems in the theater. Finally, THAAD's BM/C3I systems will manage and integrate all THAAD components by providing instructions, communications, and by processing and fusing sensor data. BM/C3I systems will also link the THAAD system to other missile and air defense systems, and to our maneuver forces in order to ensure complete interoperability with the force. All of these components will be air liftable by C-141 cargo aircraft.

The THAAD System may be used as a basis for the Navy's Theater Wide Missile Defense on its AEGIS class warships. Currently, studies are underway to determine the feasibility of creating a seaborne, or marinized, THAAD system.

THAAD Area Defense



ABM TREATY COMPLIANCE

The 1972 ABM Treaty between the former Soviet Union - now represented by Russia - and the U.S. limits the development of anti-ballistic missiles in order to preserve strategic deterrence. The U.S. has worked to ensure THAAD's compliance with the provisions of the ABM Treaty. The fourteen THAAD tests have all been certified compliant, and we are working with our ABM Treaty partners to further define the nature of the Treaty and reach a final agreement on the status of ballistic missile defenses.

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FACT SHEET

BMDO FACT SHEET 95-001

NAVY THEATER-WIDE BALLISTIC MISSILE DEFENSE PROGRAM

BACKGROUND

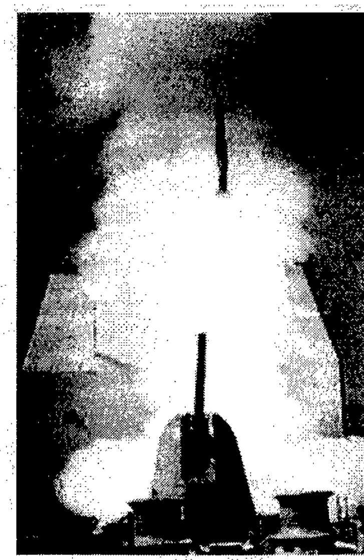
The Navy Theater-Wide Defense (NTWD) program will provide U.S. forces an upper-tier ballistic missile defense capability without the need for land bases. Taking advantage of the mobility of Navy ships, this system could be the first deployed in a region. It will intercept attacking missiles in their ascent, near apogee and descent phases, thereby providing a large and highly-effective, layered regional defense.

The Navy and the Ballistic Missile Defense Organization (BMDO) are working in partnership to develop and deploy the systems that will meet future operational requirements for theater missile defense (TMD). It is the second evolutionary stage of the joint BMDO-Navy TMD program which builds on the Navy Area Defense program.

NTWD will use an interceptor with exo-atmospheric (outside the atmosphere) capability. The system will be deployed on existing AEGIS cruisers and destroyers using the SPY-1 radar and the vertical launch system.

OBJECTIVES

- **Expand Navy Theater Ballistic Missile Defense to provide increased depth of fire and defense across an entire region**
- **Modify the AEGIS weapon system to support employment of the Standard Missile with a kinetic (hit-to-kill) vehicle**
- **Integrate a kinetic kill vehicle with the Standard Missile**



Standard Missile launched from an AEGIS cruiser.

MISSILE

There are two interceptor concepts under consideration for the NTWD program. The first is a Lightweight Exo-Atmospheric Projectile (LEAP) interceptor that would be integrated with the Navy's Standard Missile (SM-2 Block IV), a proven air defense missile already part of the AEGIS weapons system. The second concept is a modified Theater High Altitude Air Defense (THAAD) system. THAAD is currently undergoing development and testing by the Army.

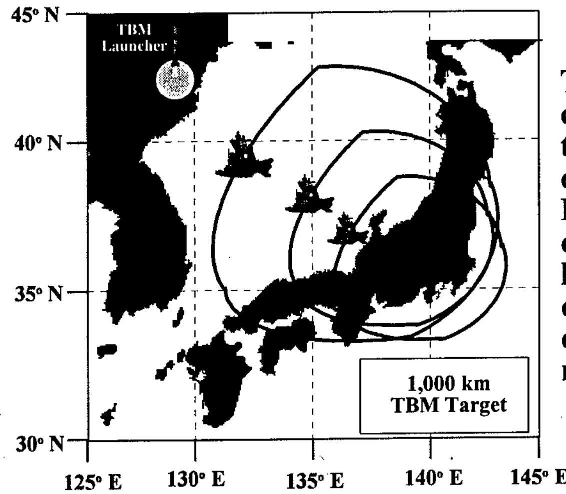
The BMDO-Navy Terrier LEAP Technology Demonstration Program has completed the first phase of missile systems engineering to integrate the LEAP projectile with the Standard Missile. During attempts at intercepting a target outside the earth's atmosphere, LEAP technology components performed well. Significant data was collected during the flight experiments.

A Cost and Operational Effectiveness Analysis (COEA) is in progress to assess system alternatives. A milestone decision should be made in FY 1998. The system should be deployed early in the next century.

NAVY TACTICAL BALLISTIC MISSILE DEFENSE STRATEGY

- **Evolve the AEGIS fleet through modernization**
  - **Preserve multi-mission system integrity**
  - **Add ballistic missile defense capability and maintain existing cruise missile capability**
- **Deploy Navy Area Defense capability as quickly as possible**
- **Continue AEGIS evolution to add Navy Theater-Wide capability**
- **Introduce enhancements to pace threat evolution**

Defended Area Increases as Ships are Positioned Closer to the Threat



The Theater-Wide concept capitalizes on the inherent mobility offered by Navy ships. By positioning a ship closer to the threat launch point, a significant increase in the defended area can be realized.

COMMAND AND CONTROL

The Navy has years of experience with Battle Force air defense and has already deployed the command and control systems necessary to support initial TBM defense from the sea. The ability to integrate satellite communications, the Joint Tactical Information Distribution System (JTIDS), Tactical Related Applications/ Tactical Receive Equipment (TRAP/TRE), Naval Tactical Command System-Afloat (NTCS-A), and to incorporate other emerging intelligence, sensor, and tactical information systems makes the Navy a logical choice to participate in the TMD mission.

AEGIS SHIPS

TICONDEROGA CLASS GUIDED MISSILE CRUISER (AEGIS) (CG)

Displacement: 9450 Tons
Dimensions: Length - 567 ft
Width - 55 ft
Speed: 30+ knots

ARLEIGH BURKE CLASS GUIDED MISSILE DESTROYER (AEGIS)(DDG)

Displacement: 9200 Tons
Dimensions: Length - 509 ft
Width - 66 ft
Speed: 32+ knots

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BMDO FACT SHEET 96-002

MEDIUM EXTENDED AIR DEFENSE SYSTEM (MEADS)

INTRODUCTION

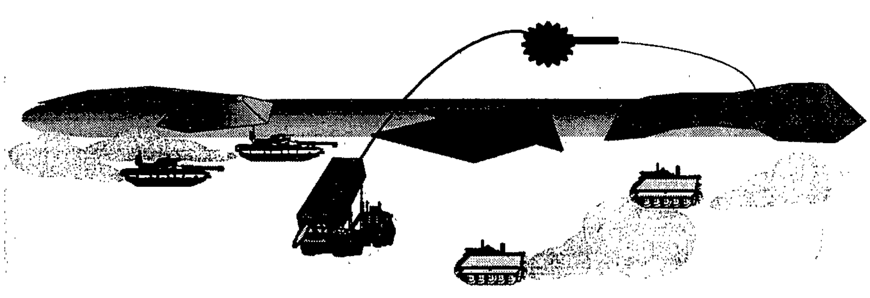
In the coming decades, NATO is likely to become increasingly engaged in maintaining and restoring regional peace, often in an international coalition. To undertake this mission with the greatest chance of success, NATO forces must be able to rapidly deploy to regional crises, work with our allies' forces, conduct fast moving ground combat, and protect themselves from air and missile attack. The Medium Extended Air Defense System (MEADS) is specifically designed to meet these future requirements.

MISSION

MEADS will defend troops and fixed assets from short range ballistic missiles, cruise missiles, and other air breathing threats such as aircraft or unmanned aerial vehicles. MEADS role in the ballistic missile defense architecture will be to bridge the gap between man portable systems like the Stinger and the higher levels of the missile defense structure like the Patriot Advanced Capability-3 (PAC-3) or the Theater High Altitude Area Defense (THAAD) system while providing continuous coverage for rapidly advancing maneuver forces.

MEADS will also help U.S. forces work in conjunction with the forces of our allies. Since the U.S., Germany, France and Italy are planning to co-develop and use MEADS, its commonality of system design will contribute to the interoperability of U.S. and allied forces.

Medium Extended Air Defense System



MEADS' defining characteristic will be its tactical and strategic mobility. In other words, its ability to be easily deployed to a theater and, once there, its ability to keep pace with our fast moving maneuver forces. When completed, MEADS will be the only missile defense system able to roll off transports with the troops and immediately begin operations. Moreover, MEADS will have greater firepower and require less manpower than its predecessors.

SYSTEM DESCRIPTION

MEADS will be a mobile surface to air missile (SAM) system designed to provide a lower tier defense for troops and installations against a sophisticated suite of threats. Preliminary concepts show that the system will be mounted on either a wheeled or tracked vehicle. MEADS is likely to use a multi-canister vertical launcher to protect and launch its interceptors. MEADS will have advanced radars to provide 360 degree coverage. The MEADS missile is likely to be hit-to-kill, meaning it will destroy its target in a catastrophic collision.

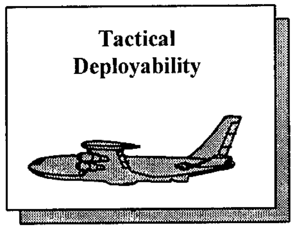
All components will be linked by state of the art communications and will have access to a broad range of sensors from other systems and services. MEADS will use a distributed/netted architecture and module components that will allow a MEADS unit to be task-organized and configured according to the expected threat and planned tactics. These abilities will ensure that MEADS is part of the overall Air Defense/Theater Missile Defense architecture and compatible with other Army, joint, and allied systems.

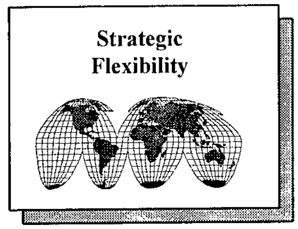
INTERNATIONAL COOPERATION

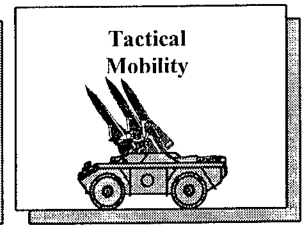
The Medium Extended Air Defense System traces its U.S. origins to the Corps SAM project of the late 1980s and early 1990s. Corps SAM, a joint Army and Marine Corps program, was intended to replace the rapidly aging HAWK air defense system that had been in service since the early 1960s. The Army and Marine Corps started Corps SAM in recognition of their common need to find a new air defense system against air and theater short to medium range missiles that can be rapidly deployed anywhere in the world.

In the early 1990s, Germany expressed an interest in joining the Corps SAM program and cooperating on system development and production. Like the US, German interest stemmed from a need to replace aging HAWK systems. Soon afterward, France and then Italy came forward to express their interest in joining. The four partners agreed to work toward creating this new international venture. One of the first concrete steps in this cooperation came with the signing of a joint Statement of Intent in February 1995. At this point, Corps SAM became officially known as MEADS. The four partners are scheduled to sign a Memorandum of Understanding (MOU) in the third quarter of FY1996 to commence the Project Definition-Validation (PD-V).

MEADS' international nature gives the program a high potential to promote interoperability of U.S. and allied forces and to help trans-Atlantic defense cooperation. In turn, this could reinforce good relations between the U.S. and Europe. Henri Conze, the director of the French Defense Ministry's procurement agency, has stated that MEADS, "Marks the new spirit of cooperation that should reign in the post-Cold War world." Indeed, MEADS reaffirms the United States' commitment to stay involved in European security affairs and could spark a renaissance in trans-Atlantic cooperation.







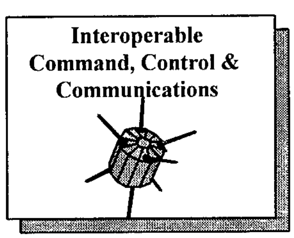
PROGRAMMATICS

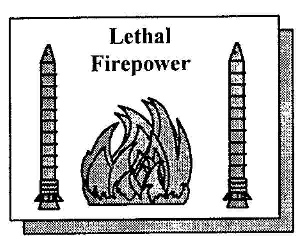
The U.S. and its European partners have agreed to split work shares and development costs by a ratio of 50-20-20-10 for the U.S., Germany, France, and Italy, respectively, although each party has only made commitments to the PD-V phase. The February 1995 Statement of Intent reaffirmed this agreement and laid out the method to manage the procurement process. According to the agreement, a multilateral Steering Committee will supervise the NATO MEADS Management Agency that will provide program oversight. Germany will provide the first General Manager. Afterward, the position will rotate between the three European participants. The U.S. will provide the Deputy General Manager. Additional NATO countries may join the MEADS effort if all participating countries approve.

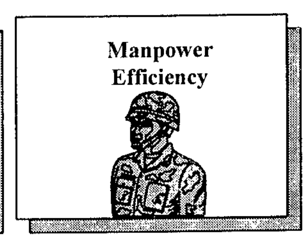
The Statement of Intent also detailed the process that will be used to choose a contracting team to build the system. The process pairs two U.S. teams, one led by Hughes & Raytheon and the other by Lockheed Martin, with two European teams, each comprised of Daimler-Benz, Siemens, Aerospatiale, Thomson-CSF, and Alenia. The two resulting international teams will ultimately compete for the final contract.

The MEADS project will pass through three phases: PD-V, Design and Development (D&D), and Production. MEADS is currently preparing to enter the first stage, PD-V. The objective of PD-V is to produce a system specification, a primary end item specification document, and a cooperative program plan for the common development and production of MEADS. The participating countries will negotiate a MOU for each of these three phases.

Should the decision be made to allocate resources to move MEADS through to the Production phase, low rate initial production could start in 2003. Following operational test and evaluation of these initial systems, MEADS could enter full rate production. The first MEADS units could reach the field as early as 2005.







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BMDO FACT SHEET 96-005

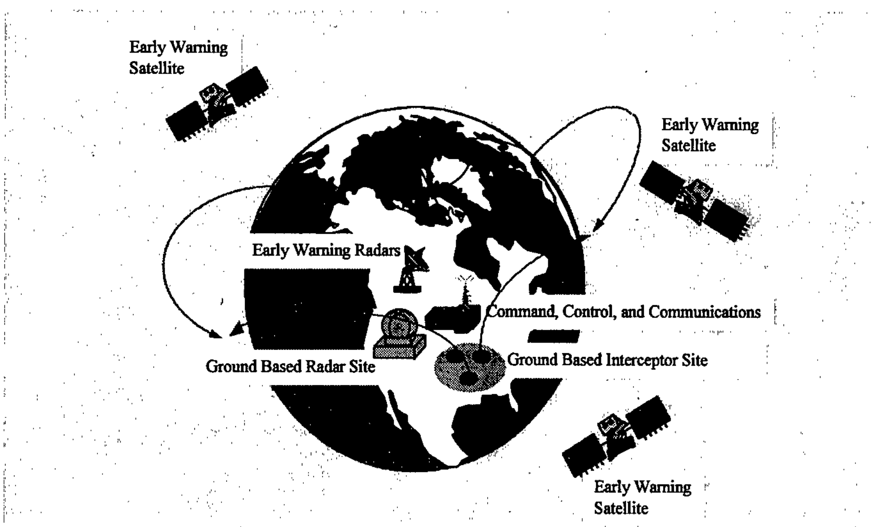
NATIONAL MISSILE DEFENSE PROGRAM

INTRODUCTION

It is incumbent to move forward with all deliberate speed to develop the technology and systems for a national missile defense.
—General Shalikashvili, Chairman, Joint Chiefs of Staff, 1995

If the North Koreans field the Taepo Dong 2 missile, Guam, Alaska, and parts of Hawaii would potentially be at risk.
—then Deputy Secretary of Defense John Deutch, 1994

The U.S. traditionally has relied on the wide expanses of the Atlantic and Pacific oceans to keep our homeland at arms length from the turmoil of global conflict. However, the proliferation of long range ballistic missiles and weapons of mass destruction may negate much of this advantage and possibly deliver a serious blow to U.S. national security.



THE PROBLEM OF PROLIFERATION

At present, only a few countries — including Russia, Ukraine, and China — possess missiles that can strike the U.S., but the chance that this number will increase cannot be ignored. Today, technology is spreading around the world at an astonishing rate, including technology dealing with ballistic missile development and, more ominously, with weapons of mass destruction.

Complementing this growing technological capability is the continuing intent among some regimes to harm the international system, particularly the U.S. and its allies. Furthermore, it is impossible to predict whether traditional notions of deterrence will operate under future conditions. Official estimates predict that a hostile regime may develop or buy a long range ballistic missile within just fifteen years.

NMD MISSION

These trends establish an uncertain but potentially harmful threat to U.S. national security. As a result, the Ballistic Missile Defense Organization (BMDO) balanced technological development, affordability, the potential threat, and international treaty considerations to establish the National Missile Defense (NMD) program.

The NMD program is distinct in that it is not an acquisition program, but a deployment readiness program designed to develop and maintain the option to deploy an NMD system if the need arises. Therefore, its mission is to reduce the leadtime required to deploy an Anti Ballistic Missile (ABM) Treaty compliant system as a hedge against an uncertain threat.

If emergency deployment is required, an NMD site would protect the U.S. against limited strikes or accidental launches of long and intermediate ranged missiles. However, it would not be capable of repelling large massed attacks.

Development of NMD technology also may reduce the strategic value of long range missiles before they become commonly viewed as an essential component of international power and prestige.

NMD SYSTEM

Although no deployment has been authorized, the NMD deployment readiness program is completing technology development with the goal of maturing the key components enough to field. These key components include a ground based interceptor (GBI), a ground based radar (GBR), Battle Management/Command, Control, and Communications (BM/C3) and sensor technology.

GBI: The GBI program is developing, demonstrating and validating the technology and components for a state-of-the-art, cost-effective, lightweight, non-nuclear, hit-to-kill missile to intercept and destroy inter-continental ballistic missiles targeted against the U.S. Developing the GBI is the highest priority in the NMD program. This program consists of two efforts: the Exoatmospheric (outside the atmosphere) Kill Vehicle (EKV) and the Payload Launch Vehicle (PLV).

The EKV efforts concentrate on the difficult technical issues of the interceptor front end. The EKV design is currently under critical review and will undergo seeker fly-by tests in FY97.

The PLV efforts take advantage of readily available and proven boosters for EKV flight testing. This low-cost approach allows BMDO to delay development of an optimized GBI booster and focus efforts and investments on the kill vehicle's development.

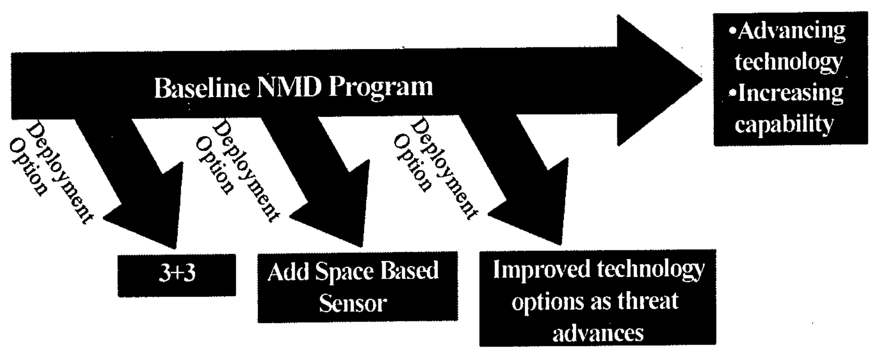
GBR: The NMD GBR is planned to provide target tracking, discrimination. Currently NMD program developers are constructing a testbed radar to resolve several technical issues.

BM/C3: The BM/C3 project is focused on integrating the NMD interceptor and sensor operations in support of informed decision making. At present, the BM/C3 element is primarily intended to help find the best NMD command and control structure, develop a communications architecture for the entire NMD system, and to facilitate NMD program integration.

Other vital components are the Space Based Infrared System and the Space and Missile Tracking System. Although not funded by BMDO, these systems play critical roles in theater and national missile defense by providing surveillance, warning and track data to overall missile defense operations.

PROGRAM SCHEDULE

Over the next two to three years, flight tests are planned at the national test range in the Pacific to first test these elements individually and then together as a system. If successful, these tests may indicate that an effective and affordable NMD system can be built if needed. The NMD Program schedule is designed to allow flexibility according to the global threat, offering several increasingly capable deployment options as the Baseline NMD Program progresses. The 3+3 option will enable the US to develop, within three years, the ability to deploy elements of an NMD system within another three years. Increasingly capable deployment options after 3+3 will add further capability with more elements of the NMD system.



ABM TREATY

The 1972 ABM Treaty between the U.S. and the Soviet Union — now represented by Russia — helps preserve strategic stability by limiting the deployment of anti ballistic missiles. The BMDO NMD program complies with the ABM Treaty as it is a technology development, and not an acquisition, program. The U.S. and its treaty partners are currently working to further mutual understanding of the Treaty and of theater ballistic missile defenses.

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INNOVATIVE SCIENCE AND TECHNOLOGY PROGRAM

INTRODUCTION

The Ballistic Missile Defense Organization (BMDO) depends on advanced technology of all kinds to invigorate its ability to defend against increasingly sophisticated ballistic missile threats. The BMDO has traditionally nurtured technology with a major impact in other defense sectors and in the national economy. Today, the BMDO spurs scientific innovation and enhances our economic security due to its ongoing emphasis on advanced technology. These two considerations require the BMDO to continue to foster advanced research and development of new technologies in commercial and military sectors.

THE ROLE OF THE INNOVATIVE SCIENCE AND TECHNOLOGY PROGRAM

The Innovative Science & Technology (IS&T) program is at the forefront of scientific innovation in the Ballistic Missile Defense Organization. IS&T is a broad scientific effort intended to help the BMDO solve the total ballistic missile problem by expanding the architectural options available for ballistic missile defense. In broadest terms, IS&T seeks to expand the kinds of technology available to the BMDO in all fields. This mission involves IS&T in diverse projects such as imaging, communications, sensors, power generation, propellants, miniaturization, and wide-bandgap materials.

OBJECTIVES OF THE INNOVATIVE SCIENCE AND TECHNOLOGY PROGRAM

- **Technology Transition -- Find new ways to transition promising technology from the research phase into early development;**
- **Commercialization -- Aggressively move defense technology into the private sector to enhance economic security;**
- **Innovation -- Encourage and sponsor forefront research and development to enhance national security;**
- **Education -- Assist the quality training of student scientists and engineers in disciplines critical to national security.**

IS&T enhances ballistic missile defense options by expanding the capabilities of limited successes or by creating entirely new capabilities. The IS&T program pursues speculative, high risk technologies that could spur a revolutionary leap in capability, fulfilling BMDO's need for a bold and ambitious research program that is not limited to a single area of missile defense capability. Its founding principle is to establish a government funding office to quicken the pace of technology development and decrease the amount of time needed to transform scientific breakthroughs into reality.

IS&T FUNCTIONS

The IS&T program has two major thrusts. First, it provides seed funding to promising technologies and moves those technologies into advanced technology demonstrators. Second, the IS&T program transfers technology to the private sector. With these two broad goals, the IS&T program nurtures scientific research, accelerates the most promising ideas toward application, and fosters breakthroughs in a wide variety of advanced technologies.

The IS&T follows several basic principles in working toward its goals. The first is to respond quickly to breakthroughs and unique opportunities with funding. Second, IS&T limits the layers of technical management between the sponsor and investigator to one. Third, basic research and preliminary development are sponsored in parallel to expedite delivery of a product. Fourth, IS&T assists the development of an invention, from inception to feasibility demonstration. Fifth, IS&T strives to forge strong interaction between government, universities and industry to speed development of a product. Finally, it explores novel techniques to move military technology into industry.

Currently, IS&T maintains six broad program areas under which the individual projects are categorized. They are:

(1) Information processing and computer technology;

(2) Sensing, discrimination, and phenomenology;

(3) Space power and power conditioning;

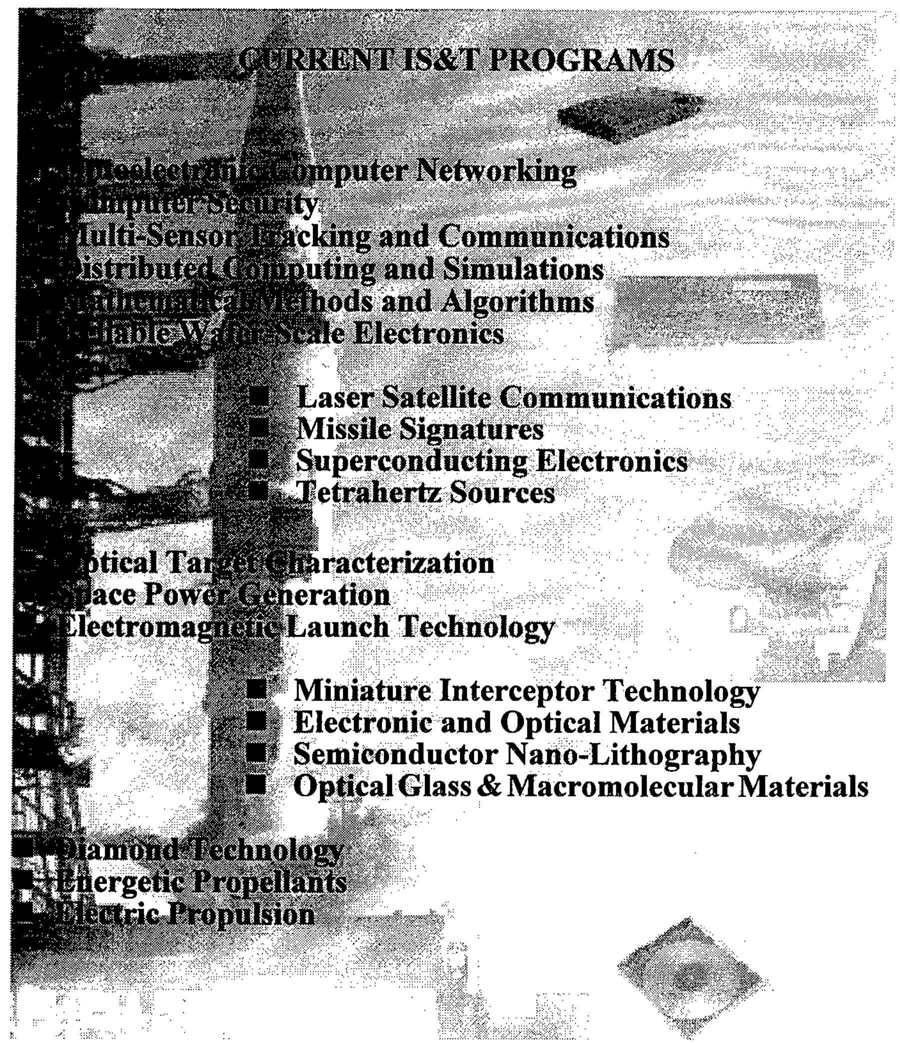
(4) Directed and kinetic energy concepts;

(5) Materials and structures;

(6) Propulsion and propellants.

The IS&T program is a collaborative effort between the core IS&T staff, science and technology officers in other government research agencies, and more than 1,000 scientists and engineers in industry and academia. Science and Technology Agents (STAs) within the directorate manage the technical aspects of IS&T sponsored research. Each STA is affiliated with a defense research agency, such as the Office of Naval Research or the Army Research Office.

IS&T also maintains a Technology Applications division that promotes spin-off technologies from IS&T research to civilian and defense programs in industries such as aerospace, electronics, and medicine. Finally, the IS&T program administers the Small Business Innovative Research Program that seeks to innovate technology specifically from small businesses.



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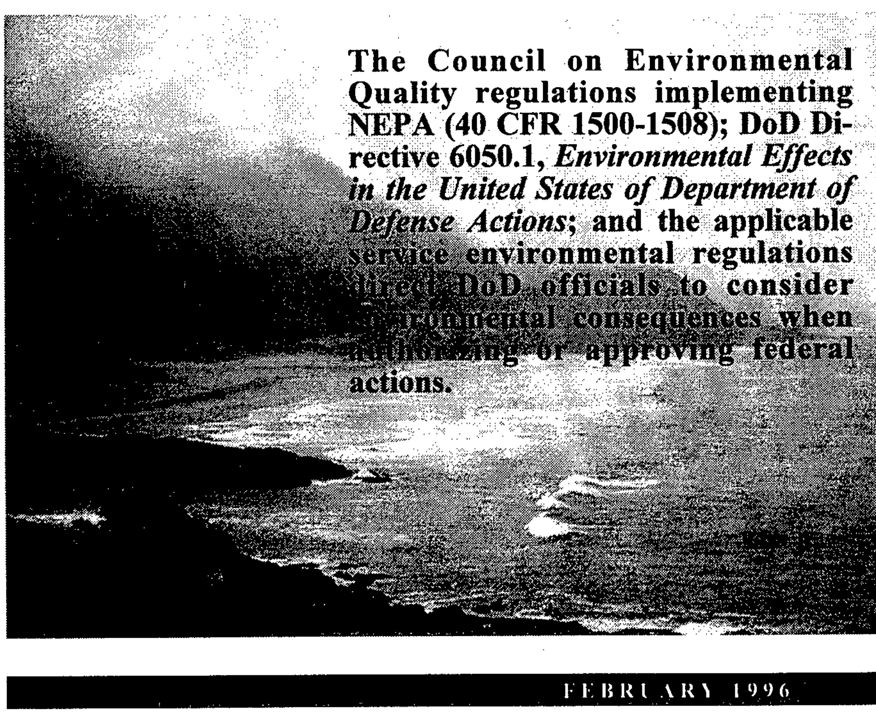
THE BALLISTIC MISSILE DEFENSE PROGRAM AND ENVIRONMENTAL PROTECTION

INTRODUCTION

The Department of Defense (DoD) has established an Environmental Impact Analysis Process (EIAP) for integrating environmental considerations into its decision-making as required by the National Environmental Policy Act (NEPA). The EIAP establishes the timing and scope of environmental impact analysis documentation to ensure that adequate environmental planning information is available to support program decisions.

The Ballistic Missile Defense Organization (BMDO) has completed a variety of environmental analyses to support its activities. NEPA documentation supported the transition of the ballistic missile defense (BMD) research program from its earlier stages into technology-specific research. In 1987 the Strategic Defense Initiative Organization (SDIO) prepared a number of Environmental Assessments (EAs) which analyzed the potential effects of the boost surveillance and tracking system, exoatmospheric (outside the atmosphere) reentry vehicle interceptor subsystem, ground-based surveillance and tracking system elements and battle management/command, control and communications (BM/C3). The BMDO has prepared various Environmental Impact Statements (EIS) and EAs for the national test ranges and research facilities being used for work on BMD programs.



The BMDO has prepared two Programmatic Environmental Impact Statements (PEIS) which analyze the potential environmental effects associated with research and development of BMD systems. The first PEIS, prepared by the U.S. Army Space and Strategic Defense Command, addresses the acquisition life-cycle environmental impacts for the theater missile defense (TMD) program. The second PEIS, prepared by the Air Force Center for Environmental Excellence, addresses the potential environmental impacts of BMD program development and specifically focuses on the research and development of the national missile defense (NMD) program.

ENVIRONMENTAL SETTING

The environmental setting establishes the frame of reference for assessing the potential environmental consequences from the BMD program. Most BMD testing will be conducted in a region encompassing the continental United States, Alaska, Hawaii and the Kwajalein Missile Range, located in the Republic of the Marshall Islands in the Pacific Ocean. Besides the environmental studies already conducted, DoD will undertake site-specific NEPA analyses and documentation as locations are selected to conduct BMD testing.

The BMDO has divided the environment into a set of environment specific topics. Each topic was chosen for analysis based on public comments and probable consequences of the BMD program.

ENVIRONMENTAL IMPACT

What follows is a summary of the assessments of the potential environmental consequences from the PEIS' for the TMD and NMD programs.

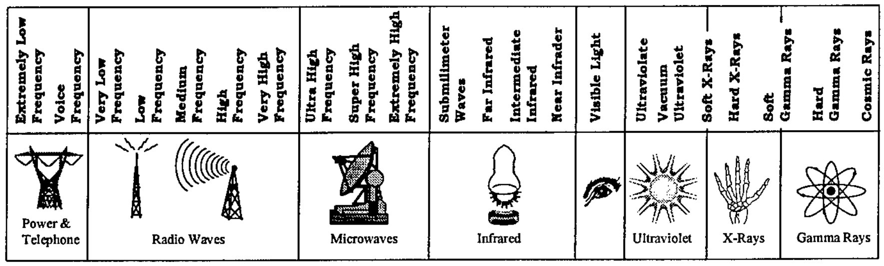
Air Quality: Due to the brief, sporadic frequency of atmospheric emissions associated with BMD activities, no substantial short- or long-term impacts are expected. Potential impacts from NMD activities include emissions from construction, power generation, hazardous propellants, rocket exhaust and hazardous industrial solvents. Impacts from TMD activities include rocket exhaust, vehicle emissions and dust.

Hazardous materials and waste management: Waste minimization, centralization of responsibility for hazardous materials, disposal planning and compliance with laws and regulations will limit potential impacts from BMD activities. Potential impacts from both NMD and TMD activities could result from handling, storage, transportation and disposal of hazardous materials and wastes.

Noise: BMD program activities will involve new construction. Activities would be limited in duration and small in scale. Rocket launches and flight tests associated with BMD activities will primarily be performed at facilities with a history of similar activities. Therefore, the cumulative impacts are expected to be minimal.

Safety: Potential impacts of NMD/TMD development and testing could include worker safety during lethality research, manufacturing, system transportation, flight testing and ground testing of radars and seekers. The implementation of safeguards, safety plans and procedures will limit potential hazards to safety.

Electromagnetic radiation (EMR): EMR impacts are expected to be minimal. BMD sources of high-frequency EMR will be localized and typically only transmit for brief periods. Potential impacts created by both NMD and TMD activities include incremental human and wildlife exposure to EMR from radars and guidance systems and power and communications systems.



Electromagnetic Spectrum

Surface water and groundwater: Cumulative impacts from the BMD program on water quality and water quantity are expected to be minimal. Inadvertent or accidental contamination of water resources due to spills, runoff, or sedimentation can be prevented by routine precautions. Surface water in the immediate vicinity of existing launch facilities could be exposed to exhaust clouds from launch and static firing activities and experience some acidification.

Cultural resources and native populations: Impacts of the NMD/TMD programs on cultural resources and native populations might occur as a result of noise, vibration, or pollution from outdoor test activities, ground disturbance of cultural resources, or disturbance of Native American religious or other cultural activities. These impacts are not expected to be significant and will be within all applicable regulations.

Biological resources and wetlands: Biological resources and wetlands could potentially be disturbed by BMD activities which might include brief episodes of noise generation, exposure of airborne wildlife to EMR, and encroachment on sensitive habitats, wetlands, or floodplains. All BMD activities will be conducted at facilities with a history of similar activities so cumulative impacts will be minimal.

Stratospheric ozone depletion and global climate change: The stratospheric ozone layer protects the surface of the earth from excess levels of solar radiation associated with ultraviolet light. Rising emissions of greenhouse gases are therorized to increase global temperatures and cause global climate change. Under the BMD program, small quantities of ozone-depleting and greenhouse gases would be released into the atmosphere. These will be a very small proportion of releases worldwide but would nonetheless cause further ozone depletion and an increase in the net global greenhouse gas emission. Atmospheric modeling has shown that worldwide rocket launches show no significant global impacts on the ozone layer. No significant increase in human health or ecological damage is expected from BMD activities.

BMDO is concerned about environmental protection and has undertaken many studies to determine the potential consequences to the environment by any of its programs. These studies have concluded that both the NMD and TMD programs can continue as planned as they will not significantly impact the environment.

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